

630-0502-023 thru 7229
024 7230



THERMOTRON

F-12-CHW-5-5

INSTRUCTION MANUAL



**IN THE BEGINNING
THERE IS PRICE**

**IN THE END,
THERE IS COST**

As a businessman, you know there are certain things you would never buy on the basis of price alone.

And probably, way up near the top of that list are environmental facilities.

Thermotron doesn't sell test chambers on price. We sell on the value of experience, services, quality and performance.

These services and performance are designed to help you prevent and control losses of production and products; and losses are what determine ultimate cost.

That's why we don't just ask for the chance to QUOTE on your business. We want the chance to show you what we can be worth in the long run.

7229
7230

THERMOTRON CORPORATION

Holland, Michigan

R. A. MARCOUILLER

DEC 13 1977

DEVELOPMENT ENGR.

MAINTENANCE MANUAL

- For -

THERMOTRON ENVIRONMENTAL CHAMBER

Temperature - Vibration

Model F-12-CHV-5-5

Serial Nos. 7229
7230

- Manufactured For -

HONEYWELL, INC.

1625 ZARTHAN AVENUE

MINNEAPOLIS, MINNESOTA

Purchase Order No. 430045-C6

THE THERMOTRON INSTRUCTION MANUAL

Thermotron instruction manuals are dedicated to assisting the reader-user toward a better understanding of Thermotron Environmental Chambers and associated equipment. Most instruction manuals are seldom read except in the time of crisis when equipment malfunction is suspected. When this happens the manual is usually missing, or at best, difficult to locate. So to start things off on the right foot, WHY NOT FIND A CONVENIENT SPOT TO KEEP THIS MANUAL?

We at Thermotron have tried to produce a usable manual. But, being human, we are subject to the frailties of behavior. Therefore, should you discover any errors or omissions, or should you wish to contribute any recommendations, send us your comments. We at Thermotron will be most appreciative.

This book is composed of many sections which are selected according to the options and variations of your specific equipment. The omission of pages or sections in the page numbering sequence of this manual does not indicate an oversight. These omitted pages contain information that does not apply to your equipment and have, therefore, been eliminated.

Component literature has been supplied for all the major components used in manufacturing this equipment. This literature is a valuable source of information, both for understanding the operation of the component and for reference in the future. An understanding of the information contained in this literature is also essential to the proper operation of this equipment. This information is complementary to the information contained in the equipment instruction manual, and both should be thoroughly read and understood before attempting to operate the equipment.

NOTICE TO ALL CHAMBER OPERATORS

When operating a chamber in a live load situation (heat dissipating product), provisions should be made to remove power from your product should a chamber power failure occur or a refrigeration or control circuit malfunction.

This chamber is equipped with a high heat limit which is set at the maximum designed limit of the chamber to protect the chamber from excessive heat. This high heat limit removes power ONLY from the chamber heaters and DOES NOT remove power from your product; therefore, a device such as the Thermotron Productsaver should be used to remove the product power to prevent the test area from exceeding temperatures that may be greater than the designed limit of the product which could cause damage.

THERMOTRON

Productsaver™ MODEL 012005

HI-LOW TEMPERATURE LIMIT CONTROL & ALARM SYSTEM

- TYPICAL ¼% ACCURACY
- THERMOCOUPLE SENSOR
- LOW COST
- FULL-SCALE INDICATION OF TEMPERATURE AND SET POINTS
- VISUAL AND AUDIBLE ALARMS PLUS CONTACT CLOSURES
- ESTABLISHES BOTH HIGH AND LOW TEMPERATURE LIMITS
- POSITIVE SENSOR BREAK PROTECTION—FAILSAFE
- HIGH ELECTRICAL NOISE IMMUNITY
- FULLY SOLID STATE—22 IC's HIGHEST QUALITY COMPONENTS
- RUGGED DESIGN
- MANUAL OR AUTOMATIC RESET
- USER-SELECTABLE OPERATING CHARACTERISTICS
- TAMPER-RESISTANT SET POINT ADJUSTMENTS

As a passive alarm unit, or a back-up limit controller, the Productsaver helps to protect your product, process and equipment from excessively high and low temperatures.



**Factory
Mutual
System**

LISTED BY FACTORY MUTUAL

SPECIFICATIONS, MODEL 012005

INPUT: Thermocouple, type T; copper/constantan. Not affected by thermocouple resistances of up to 1,000 Ohms.

RANGE: -125F to +375F with equivalent C scale (standard).

MEASURING/ALARM ACCURACY: $\pm ¼\%$ typical.

OUTPUTS:

Visual: Separate 'alarm' (ylw), 'high limit' (red) and 'low limit' (grn) warning lights.

Audible: Pulsing 2800 Hz, 70 db warning tone

Contacts: Separate 'alarm', 'high limit' and 'low limit' 1P2T contacts, rated 4A @ 115vac.

SENSOR BREAK/FAILSAFE PROTECTION: Special circuit provides full scale temperature indication, turns on 'alarm' light and turns off 'high' and 'low' limit contacts.

COLD JUNCTION COMPENSATION: Precision oven-type stabilization.

ALARM SET POINTS: Screwdriver adjustable high resolution ($\pm 0.2\%$) potentiometers. Adjustable from front panel.

INDICATION: Six-inch meter displays temperature, and set point levels when 'high' and 'low' pushbuttons are depressed at front panel.

ALARM REPEATABILITY: $\pm 0.1\%$

HYSTERESIS: Less than $\pm 0.05\%$

OPERABLE AMBIENT RANGE: $^{\circ}32F$ to $^{\circ}131F$ ($0C$ to $+55C$).

TEMPERATURE EFFECT: Less than $\pm 0.01\%/deg F$ (from $77F$) over operating range.

MAXIMUM POWER REQUIREMENTS: 115vac 50/60 Hz, 10 volt-amperes maximum.

LINE VOLTAGE EFFECT: Less than $\pm 0.03\%$ for $\pm 15\%$ line voltage changes within operating range.

HOUSING: Panel mounting unsealed aluminum case, suitable for bench service.

CONNECTORS: Screw type barrier strips

DIMENSIONS: 5.8" (14.73cm) high, 9.6" (24.38cm) wide and 8.4" (21.34cm) deep. Protrudes 7.2" (18.29cm) behind mounting panels.

WEIGHT: 6.5 lbs (2.95kg).

GENERAL INFORMATION ABOUT INSTRUMENTS & CONTROLS

unique stocking—pricing philosophy

Thermotron's standard instruments and controls are manufactured in large quantities and placed into stock in accordance with production schedules which are planned as much as a year in advance. This method of operation allows individual units to be priced at levels customarily reserved for large volume orders, eliminating arbitrary 'discount' schedules, which penalize the low-volume buyer and those who do not wish to carry large inventories.

Shipping requirements tend to fluctuate unpredictably, sometimes creating shortages during peak-load periods. In most cases, however, standard products can be shipped within twenty-four hours on an *off the shelf* basis.

factory testing

Most types of Thermotron instruments and controls are subjected to a *four-phase* testing and evaluation program:

- preassembly testing and alignment for certain subassemblies and parts
- initial test, alignment and evaluation of the final assembly, or end product
- a minimum 100 hours of 'burn in' operation
- final calibration and performance check

The object of this program is to induce, detect and correct 'infancy failures' *prior to shipping the product*. This initial 'debugging' process helps to protect both the user, and us, from expensive and disruptive service requirements after the product has been put to work in a real situation.

warranty

Thermotron instruments and controls products are *guaranteed for one year* following shipment from our factory. Failures that can reasonably be attributed to deficiencies on our part will be promptly corrected thru normal factory service methods (see below). For units under warranty there will be *no charges to the customer for parts or labor*.

factory service

Units in need of repair or overhaul may be returned to the factory in Holland, Michigan, for service. In most cases, such units will be reshipped to the customer *within twenty-four hours* of their arrival at the factory.

Customers who desire to utilize this service are requested to contact the factory in advance for a Factory Service control number, which will allow us to expedite the handling of returned units.

Detroit Area Office
P.O. Box 626
Toledo, Ohio 43694
Phone: (313) 356-5010

Los Angeles Area Office
8934 Mason Avenue
Chatsworth, California 91311
Phone: (213) 882-5030

Returned units should be packed *very carefully* prior to shipping in order to avoid higher repair costs resulting from shipping damage. Costs for this service amount to \$19.00 per hour, plus parts (*no charge for units under warranty*).

replacement parts

A complete stock of replacement parts for all products of current design is maintained at the factory in Holland, Michigan. Most items can be shipped on a '*same day*' basis for orders received prior to factory closing time.

special ranges

Most special ranges can be provided when required. For low quantity orders, such requirements are handled by modifying standard stock units. The cost of this service varies with the actual requirements:

Engineering Cost	\$75.00
Dialmasters	\$50.00
Unit Modification Costs	\$25.00

In some cases, the required range may already be available. In such cases there are no engineering or dialmaster charges. On orders where the quantity will justify a special production run, it is frequently possible to reduce or eliminate the modification cost for each unit (typically 25 units and up).

special features or functions

In general, the economics of incorporating special features or functions into standard designs improves as the quantity of the order increases. Suggested variations will be technically evaluated and quoted upon request.

custom products for oem's

Original Equipment Manufacturers frequently find that it is very difficult to procure devices which ideally match their own quality, reliability, price and application requirements. Depending upon the technical complexity and volume of the requirement, a custom design might well be economically feasible. Opportunities to participate in evaluating such requirements are invited.

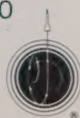
Detroit Area Office
P.O. Box 626
Toledo, Ohio 43694
Phone: (313) 356-5010

Los Angeles Area Office
8934 Mason Avenue
Chatsworth, California 91311
Phone: (213) 882-5030

San Francisco Area Office
50 Curtner Avenue
Campbell, California 95008
Phone: (408) 371-5961

THERMOTRON CORP.

KOLLEN PARK DR., HOLLAND, MICH. 49423 PH: (616) 392-1492



RECOMMENDED SPARE PARTS LIST

Thermotron recommends that its customers maintain a minimum quantity of spare parts. These parts are essential to the proper care and maintenance of your equipment, which will minimize unscheduled down time.

We strive to maintain a complete parts inventory and will be pleased to serve you if we can. All parts are shipped f.o.b. Holland, Michigan unless otherwise specified and all terms are cash in thirty (30) days.

If you require any additional information concerning parts, please contact our Parts Department for further information.

NOTE: When ordering parts, it is necessary to refer to the equipment serial number.

Parts Department
THERMOTRON CORPORATION
Holland, Michigan
Phone: 616/392-1492

At night: 616/392-1498



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RECOMMENDED SPARE PARTS LIST

Thermotron Serial Nos. 7229 and 7230

<u>Part No.</u>	<u>Computer No.</u>	<u>Nomenclature</u>	<u>Qty Per Chamber</u>
FRN8	P3FUS1FRN-8	Fuse, Control Circuit	2
FRS15	P3FUS1FRS-15	Fuse, Compressor	6
ABC-5	P3FUS1MIS-14	Fuse, Solid State Protection	2
42BE35AFL1	P3CTR7-2	Power Contactor 3P 30A	1
42BE25AFL1	P3CTR7-3	Power Contactor 4P 30A	1
42BE15AFL1	P3CTR7-1	Power Contactor 2P 30A	1
WM35AA	P3CTR8-1	HG Contactor 2P 20A	1
FRS8	P3FUS1FRS-8	Fuse, Heater	6
EL1132-5	T3HTR32-5	Chamber Heater, 4.5KW	1
63933	P3MTR1-3	Circulator Motor, 1/6 HP	1
1050QA1	P3LAM3-1	Lamp, Neon Pilot	2
KAP11AY	P3REL5-1	DPDT Control Relay	1
319B003Q1C	P3TIM2-5	Delay Timer, - 1-10 Sec. Adj.	1
D2410	P2REL1-1	Solid State Relay	1
WUY	P3THT12-2	Overheat Protection	4
151002	T3ACS151002	Thermocouple, Controller	1
151004	T3ACS151004	Thermocouple, Productsaver	1
A19	P3LAM1-2	Oven Bulb, Clear, 50Watt	1
2C647	P1BWR1-2	Blower Motor, Sound Deadening	1
FRS4	P3FUS1FRS4	Fuse, Transformer	1
P45NCA-12	P2PSS1-7	Switch, Oil Pressure	1
P70NA-1	P2PSS1-4	Switch, Hi/Low Pressure	1
AH-163-F	P2DRI3-6	Drier	1
GR-1-Z	P2VLV1EXP-23	Valve, R-502 Expansion	1
CEE-1 $\frac{1}{2}$ -GP	P2VLV1EXP-4	Valve, R-13 Expansion	1
B6F1	P2VLV3SOL-4	Solenoid, R-13 Liquid	1
A3F1	P2VLV3SOL-1	Solenoid, R-13 Small Liquid	1
-	T2TEC-1	Thermo*Tech, 2 oz.	1
-	15663	Can Valve, Thermo*Tech	1
7500K14	P3SWH3-1	Toggle Switch	1
7502K13	P3SWH3-11	Toggle Switch	1

DATA SUMMARY SHEET

MODEL: F-12-CHV-5-5

The model number defines the basic chamber:

F - Front door opening.

12 - 12 cubic feet of test space.

C - Cooling

H - Heating

V - Vibration (AGREE-type, designed to be compatible with a vibration machine).

5-5 - A 5 horsepower primary system and a 5 horsepower secondary system in combination to comprise a low temperature, cascade cooling system.

TEMPERATURE RANGE: -100°F to +350°F

TEMPERATURE TOLERANCE:

Through the specified range, the temperature stability shall not exceed plus or minus 2°F about the control point after stabilization at the control sensor.

VOLTAGE: 460/3/60 32 F.L.A.

COMPRESSOR DATA:

<u>Refrigerant</u>	<u>Make</u>	<u>Model</u>	<u>H.P.</u>
R-13	Copeland	MRF2-0500-TFD	5
R-502	Copeland	MRF2-0500-TFD	5

DATA SUMMARY SHEET

INSTRUMENTATION:

Make: Thermotron Temperature Controller.

Model: 012003.

Make: Thermotron Set Point Indicator.

Model: 013006/7.

Make: Thermotron Tape Command.

Model: 1979.

Make: Thermotron Productsaver (product temperature limit).

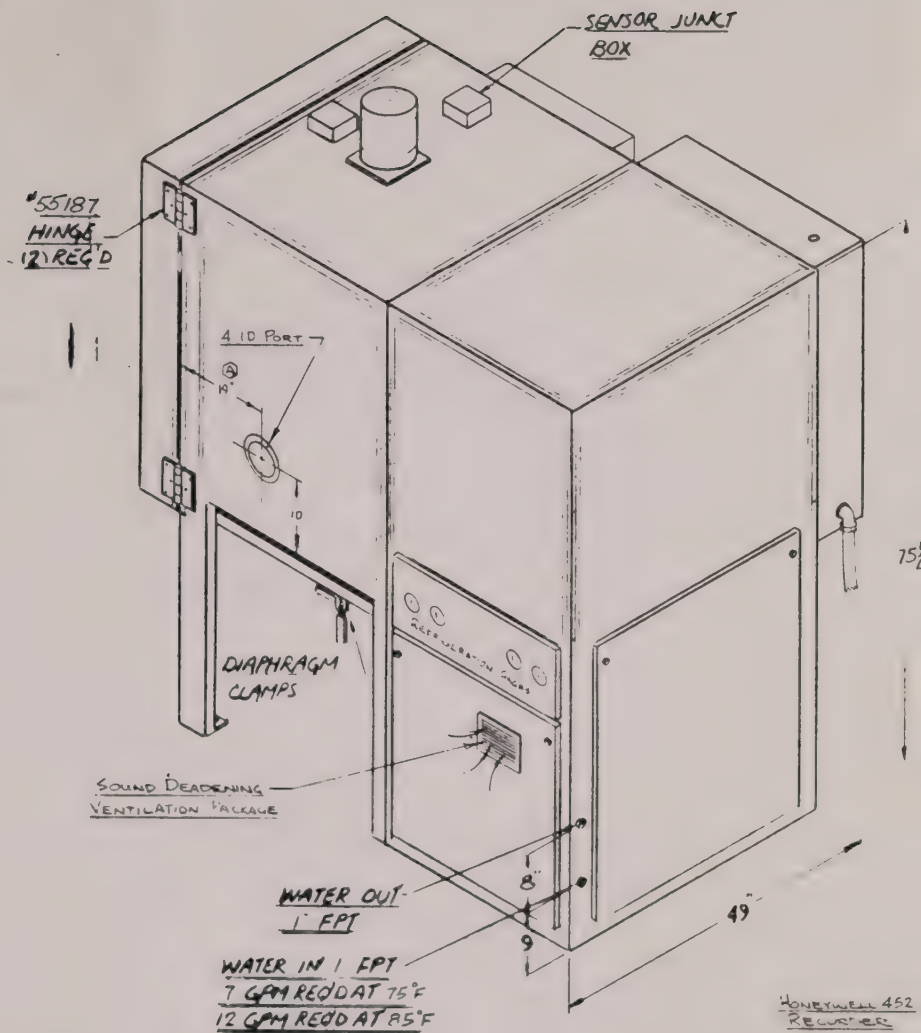
Model: 012005.

Make: Honeywell Temperature Recorder.

Model: 452X.

Range: -125°F to +357°F.

Chart: 16381.



FOR:

HONEYWELL INC

ST. LOUIS PARK, MINN. 55426

TEMPERATURE RANGE: -100°F TO +350°F

FINISH: THERMOTRON BLUE



THERMOTRON
CORPORATION

HOLLAND, MICHIGAN 49423

19' RELAY RACK PANEL MTC
BRACKET * C6607-1(X)

1/2 HP CIRCULATOR
MOTOR

LIGHT & HEATER
JUNCT. BOX

DOOR-SHAKER -
INTERLOCK SWITCH

102
LATCH

2133
page
pull

(A)
SHELF PLASTERS -
(4) REQD

DATE RECORDED: 1-1-77
RECORDED BY: J. L. SHAW

-SHAKER
INTERVIEW



THERMOTRON
CORPORATION

HOLLAND, MICHIGAN 49423

Technical drawing of a receptacle unit. The drawing shows a side view of a rectangular unit with a door. The door has a handle and a latch. The unit is labeled "RECEPT" and "500". Dimensions are indicated: 4" for the width of the door, 4" for the height of the door, and 50" for the length of the unit. The unit is labeled "MS RECEPT" and "MS 3-62A B-".

- 50 Ft CONTROL

- MS RECEPTACLE
MS# 3.C2A 8-1P

55187
HINGE
(2) REQ

✓ 41.2 Pore

DIAPHRAGM
CLAMPS

SOUND DEADENING VENTILATION PACKAGE

WATER OUT
1" FPT

WATER IN 1" FPT
7 GPM REQ'D AT 75°F
12 GPM REQ'D AT 85°F

HONEYWELL 452
RECORDER

(6) STATION SET POINT
ASSEMBLY

PRODUCTSAVER

FUNCTION SWITCHES

-TAPES COMMAND

* 1923 CONSOLE WITH
A SYSTEM 9

ER:

HONEYWELL INC.

St. Louis Park, Minn. PO

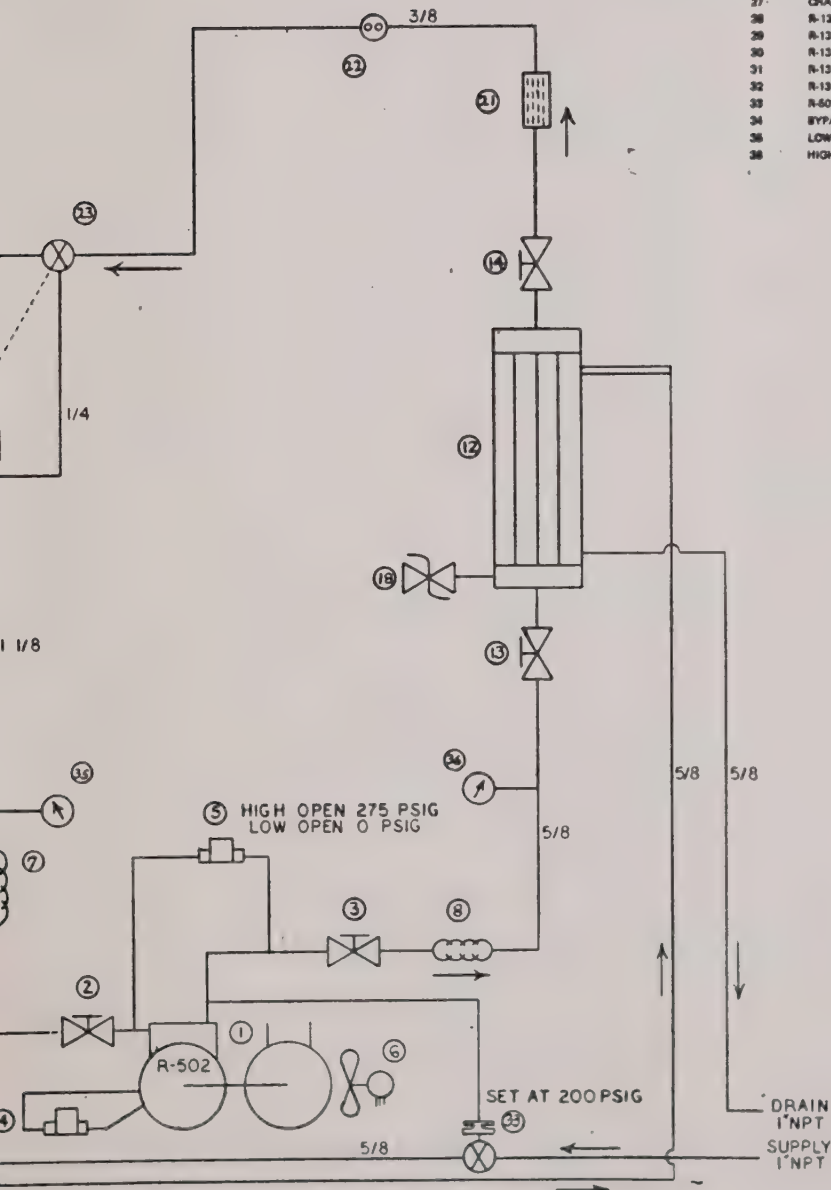
TEMPERATURE RANGE: -100°F To $+350^{\circ}\text{F}$

FINISH: THERMOTRON BLUE

[illegible]



ITEM	DESCRIPTION	MANUFACTURER	PART NO	THERMOTRON NO	QTY
1	MOTOR COMPRESSOR	COPELAND	MRF24900 TFD	P2CMPI-BN-9	1
2	SUCTION SERVICE VALVES	COPELAND	WITH UNIT		2
3	DISCHARGE SERVICE VALVES	COPELAND	WITH UNIT		2
4	OIL PRESSURE SWITCHES	PENN	PSHCA-12	P2PES-1	1
5	H/L/O PRESSURE SWITCHES	PENN	PTONA-1	P2PES-1	1
6	HEAD FAN ASSEMBLY	COPELAND	560-0214-01	P2PFI-17	1
7	SUCTION VIBRATION ELIMINATOR	ANACONDA	1010FX	P2VIB-5	2
8	DISCHARGE VIBRATION ELIMINATOR	ANACONDA	1212FX	P2VIB-5	2
9	R-13 PUMP DOWN VALVE	SUPERIOR	725A105	P2VLV3LN-1	1
10	R-13 OIL SEPARATOR	AC & R	S-5585	P2SPR-12	1
11	DISCHARGE DESUPERHEATER	THERMOTRON	2905	T2DES-2	1
12	R-502 CONDENSER	STANDARD	SET-300	P2CODI-8	1
13	R-502 CONDENSER IN VALVE	ROTOLOCK	27860	W/UNIT	1
14	R-502 CONDENSER OUT VALVE	ROTOLOCK	27717	W/UNIT	1
15	R-13 VAPOR TANK	STANDARD	2875	P2THK-2	1
16	R-13 VAPOR TANK IN VALVE	ROTOLOCK	27889	W/UNIT	1
17	R-13 VAPOR TANK OUT VALVE	ROTOLOCK	27717	W/UNIT	1
18	RELIEF VALVES	HENRY	5231-320	P2VLV3PR-3	2
19	R-13 HIGH PRESSURE DUMP VALVE	CC OF A	75200-130	P2VLV3PR-3	1
20	R-13 CASCADE CONDENSER	THERMOTRON	R-2225	P2CND-7	2
21	DRIERS	VIRGINIA	AH-163-F	P2DRS-6	2
22	R-505 LIQUID INDICATOR	SPORLAN	SA-135	P2IND-2	1
23	R-502 EXPANSION VALVE	SPORLAN	GR-1-2	P2VLV1EXP23	1
24	R-502 DISTRIBUTOR	ALCO	4-4-4	P2DIT1-8	1
25	R-13 EXPANSION VALVE	SPORLAN	CSE-1 1/2 GP	P2VLV1EXP4	1
26	R-13 DISTRIBUTOR	ALCO	4-3-4	P2DIT1-3	1
27	CHAMBER FIN COIL	SUPER	2684-3	P2CFIN-12	2
28	R-13 LIQUID SOLENOID	SPORLAN	B6F1	P2VLV350L-4	1
29	R-13 SMALL LIQUID SOLENOID	SPORLAN	A3F1	P2VLV350L-1	1
30	R-13 FLOW CONTROL	---	.064 x 2"	P2TUB-CAP-3	2
31	R-13 BYPASS SOLENOID	SPORLAN	B6F1	P2VLV350L-4	1
32	R-13 INJECTION VALVE	SPORLAN	GR-1-2	P2VLV1EXP23	1
33	R-502 WATER REGULATOR	PENN	V-45AC-1	P2VLV1WAT-2	1
34	BYPASS REGULATOR	SPORLAN	ADRSE-2 Q/30	P2VLV1PAS-1	1
35	LOW PRESSURE GAUGE	MARSH	J-6220	P2GAU1-4	2
36	HIGH PRESSURE GAUGE	MARSH	J-6080	P2GAU1-4	2



460/3/60

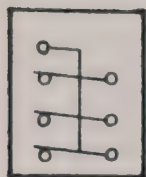
HONEYWELL INC

THERMOTRON
CORPORATION
AND, MICHIGAN 49423

NO	CHANGES	DATE	BY	CHK'D	NO	CHANGES	DATE	BY	CHK'D	TOLERANCE	DESCRIPTION
										SCALE	
										MATERIAL	
										FINISH	
										PAINT BY	
										CHECKED BY	
										RELEASED BY	
										DATE	CHANGING NO
										DATE	R-

F-12-CHV-5-5

ELECTRICAL SCHEMATIC SYMBOLS



Disconnect Switch



Compressor Fan



Fuse



Normally Open Contact



Heater



Normally Closed Contact



Thermal Actuated Switch (Heat & Cooling Limits, etc.)



Chamber Interior Light



Pressure Actuated Switch



Panel Function Light



Refrigeration Solenoid

Energizing Coil
(Contactor, Timer, Relay, etc.)

ELECTRICALLINE NUMBERS:

There are two sets of line numbers on the Electrical Schematic. The numbers to the left of the circuitry are used when referring to a component or component part on a particular line. The numbers to the right of the circuitry are used to locate the contacts of a component part. For example, a line that has an 18 after it would indicate the energizing coil of a component is closing a contact located on Line 18. On Line 18 you would find the labeled contact that corresponded to the component energizing coil. Several numbers after a line indicate there are several contact locations on the schematic.

Variations of numbers are as follows:

- X - Contact is located on Line X.
- X - Contact is located on Line X and is wired normally closed.
- X TC - Contact on Line X is timed to close.
- X TO - Contact on Line X is timed to open.
- P - Contact is located in the power section.

COMPONENT LOCATION:

To assist you in physically locating the component parts of this equipment, the electrical parts list has been coded. The code is listed under the column headed location (LOC). The column symbols are as follows:

- P - Component parts are mounted on the electrical panel.
- M - Component parts are mounted on machinery section.
- CO - Component parts are mounted in electrical console.
- CH - Component parts are mounted on chamber.
- EC - Component parts are mounted in electrical compartment.

ELECTRICAL

HIGH HEAT LIMITS:

The high heat limit is the prime protective device in the heating system on this chamber. It is, therefore, extremely important that it is properly adjusted and tested.

HEAT LIMIT ADJUSTMENT:

The heat limit is factory adjusted to open when the chamber temperature is approximately +350°F. (+177°C.), the highest operating temperature of the chamber.

The heat limit is a manual reset type. Once the setting has been exceeded, the reset button must be manually depressed.

PERIODIC CHECKS:

It is a good practice to check the heat limit when the opportunity presents itself. For example, if you have been working on the instruments, set the set point of the controller above the setting of the heat limit, and allow the chamber temperature to rise. The heat limit should open. (Push the manual reset button.) This check takes only a few minutes.

NOTE

The high heat limit is installed to protect the chamber from exceeding its limits. It is not intended for customer product protection.

RESISTANCE TEMPERATURE TABLE

FOR

PLATINUM RESISTANCE THERMOMETER ELEMENTS (100 ohms at 0°C/32°F)

Thermotron #I-2005A Thermotron #I-2010A Thermotron #I-2019A Degussa Sensors			Burns Sensors			YSI-Sostman, Model 4150 Series Sostman, Model 4100 Series		
Temperature		Resistance of Element (Ohms)*	Temperature		Resistance of Element (Ohms)*	Temperature		Resistance of Element (Ohms)*
°C	°F		°C	°F		°C	°F	
+380.0	+716	240.15	+380.0	+716	242.05	+380.0	+716	242.66
+360.0	+680	233.19	+360.0	+680	234.99	+360.0	+680	235.59
+340.0	+644	226.18	+340.0	+644	227.89	+340.0	+644	228.45
+320.0	+608	219.13	+320.0	+608	220.74	+320.0	+608	221.26
+300.0	+572	212.03	+300.0	+572	213.55	+300.0	+572	214.06
+280.0	+536	204.88	+280.0	+536	206.31	+280.0	+536	206.76
+260.0	+500	197.70	+260.0	+500	199.02	+260.0	+500	199.45
+240.0	+464	190.46	+240.0	+464	191.68	+240.0	+464	192.08
+220.0	+428	183.17	+220.0	+428	184.30	+220.0	+428	184.65
+200.0	+392	175.84	+200.0	+392	176.87	+200.0	+392	177.23
+180.0	+356	168.47	+180.0	+356	169.34	+180.0	+356	169.68
+160.0	+320	161.04	+160.0	+320	161.87	+160.0	+320	162.13
+140.0	+284	153.57	+140.0	+284	154.30	+140.0	+284	154.53
+120.0	+248	146.06	+120.0	+248	146.68	+120.0	+248	146.87
+100.0	+212	138.50	+100.0	+212	139.02	+100.0	+212	139.20
+80.0	+176	130.89	+80.0	+176	131.31	+80.0	+176	131.42
+60.0	+140	123.24	+60.0	+140	123.55	+60.0	+140	123.64
+40.0	+104	115.54	+40.0	+104	115.75	+40.0	+104	115.80
+20.0	+68	107.79	+20.0	+68	107.90	+20.0	+68	107.90
0.0	+32	100.00	0.0	+32	100.00	0.0	+32	100.00
-17.8	0	93.01	-17.8	0	92.94	-19.5	-4	91.98
-28.9	-20	88.61	-28.9	-20	88.51	-40.0	-40	83.96
-40.0	-40	84.21	-40.0	-40	84.06	-60.0	-76	75.75
-51.1	-60	79.81	-51.1	-60	79.59	-62.2	-80	75.01
-62.2	-80	75.39	-62.2	-80	75.11	-67.8	-90	73.64
-73.3	-100	70.95	-73.3	-100	70.60	-73.3	-100	70.45

*For 200 ohm platinum elements multiply above resistance values by 2. For 500 ohm platinum elements multiply above resistance values by 5.

RELAYS

Reference: Electrical Schematic No. E-7229-W.

CR1 Cooling control relay.

Coil on line #16.

Contact on line #21.

Function: To apply power to R-13 small liquid solenoid.

H1 Heat 1 contactor.

Coil on line #12.5.

Contacts on line #4.

Function: Low heat for control provides for reduced wattage from the heating circuit.

H2 Heat 2 contactor.

Coil on line #14.

Contacts on line #4.

Function: High heat for fast temperature change. Provides for maximum wattage from the heating circuit.

MH Master heat contactors.

Coil on line #11.

Contacts on line #3 & 12.

Function: Heater safety contactors to de-energize with heat limit (HLS, line #11). Energized whenever power is applied to the chamber control circuits and the chamber temperature does not exceed the limit of the safety devices.

TM1 Delay timer #1 - (high heat delay timer).

Coil on line #15.

Contact on line #15.

Function: To delay energizing contactor H2.

RELAYS

TM2 Delay timer #2 - (large R-13 cooling solenoid delay).

Coil on line #16.

Contact on line #19.

Function: To delay energizing the large R-13 solenoid for 1 to 10 seconds.

13 R-13 compressor contactor.

Coil on line #17.

Contacts on line #3.

Function: To energize R-13 compressor.

502 R-502 compressor contactor.

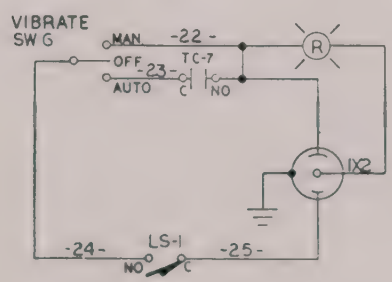
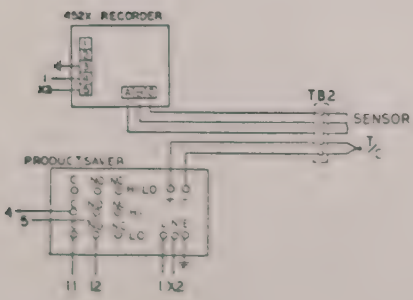
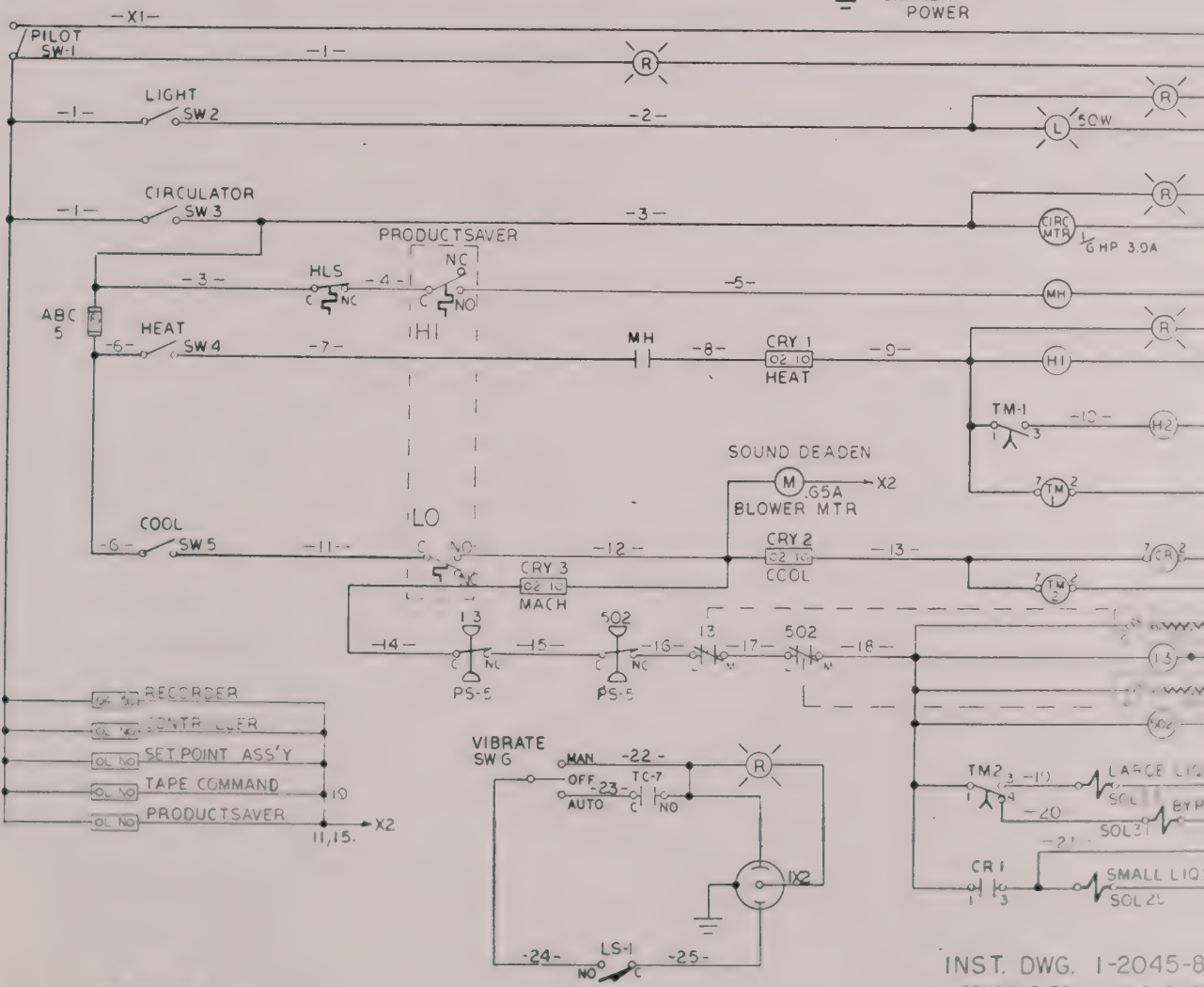
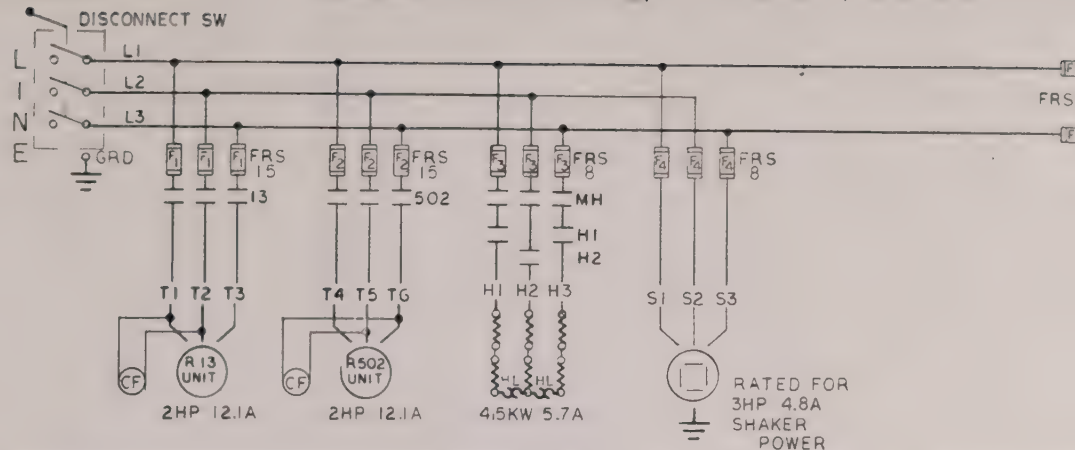
Coil on line #19.

Contacts on line #3.

Function: To energize R-502 compressor.

POWER SUPPLY
460 3 GO
32 FLA

RECOMMENDED
SERVICE
60AMPS



10 COND
CABLE '22

MS CONNECTOR
PULL 10 CONDUCTOR
CABLE THROUGH 50'
SEALTITE

26	A	RED
27	B	WHITE
28	C	BLUE
29	D	BLACK
30	E	ORANGE
31	F	PURPLE
32	G	GREEN
33	H	TAN
34	I	BROWN
35	J	YELLOW

INST. DWG. I-2045-8

CONSOLE TB-1--(2)G, (3)X2,

PANEL TB-1--(2)G, (4)X2, (1)X

INTERCONNECT--G, X1, X2

4 SPARES

ONE IN SEALTITE 50'

PANEL 25W 33 1/2" H ELECT

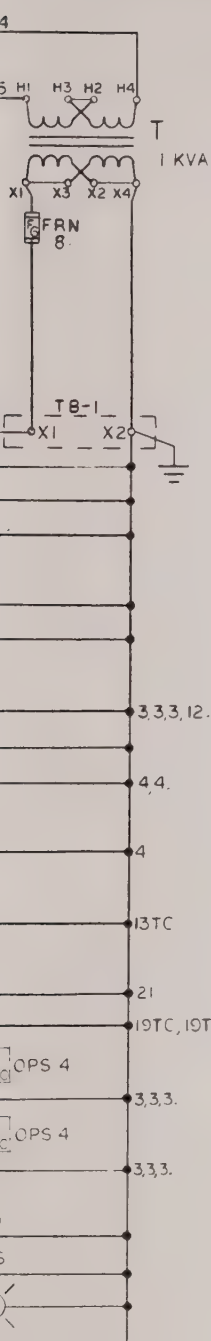
LAST NO. 34

CHANGE CHART DRIVE M

WIND SHIELD

HOLLYWE





2, X1, 2-9, 11-14, 21-35 4 SPARES
 X1, 2-5, 7-10, 12-22, 24-35 4 SPARES
 2, 3, 4, 5, 7, 8, 9, 12, 13, 14, 21, 24-35

10 COND CABLE
 ANEL I-2014
 FROM 50HZ TO 60HZ

LOC	SYMBOL	DESCRIPTION	MFG.	PART NO	TERMINAL NO	QTY
P	TB 1	CONTROL CIRCUIT TERMINALS	SQUARE D	9080KCA1	P3TRB3-1	43
P	DISC SW	60A DISCONNECT SWITCH	WESTINGHOUSE	2607D63G06	P3SWH11-2	1
P	NO FUSE KIT	NO FUSE KIT	WESTINGHOUSE	313C590G14	P3SWH11-3	1
P	HANDLE	DISC SWITCH HANDLE	WESTINGHOUSE	47A4446G21	P3SWH11-4	1
P	SHAFT	DISC SWITCH SHAFT	WESTINGHOUSE	2607D64G01	P3SWH11-5	1
P	TB KIT	TERMINAL END KIT	WESTINGHOUSE	9080K1	REF	1
P	F 1, F 2	COMPRESSOR FUSES	BUSS	FRS 15	P3FUS1FRS15	6
P	F 3, F 4	HEATER & SHAKER FUSES	BUSS	FRS 8	P3FUS1FRS-8	6
P	F 5	TRANSFORMER FUSES	BUSS	FRS 4	P3FUS1FRS-4	2
P	F 6	CONTROL CIRCUIT FUSES	BUSS	FRN 8	P3FUS1FRN-8	1
P	FUSE BLK	FUSE BLOCK 3P 30A 600V	MARATHON	6F30A3	P3FUB1-11	4
P	FUSE BLK	FUSE BLOCK 2P 30A 600V	MARATHON	6F30A2	P3FUB1-10	1
P	FUSE BLK	FUSE BLOCK 1P 30A 250V	MARATHON	F30A1SP	P3FUB1-1	1
P	13-502	POWER CONTACTOR 3P 30A	FURNAS	42B35AFL1	P3CTR7-2	2
P	H 2	POWER CONTACTOR 2P 30A	FURNAS	42B15AFL1	P3CTR7-1	1
P	H 1	MERCURY CONTACTOR 2P 35A	MAGNECRAFT	WM35AA	P3CTR8-1	1
P	CR 1	DPDT CONTROL RELAY	P & B	KAP11AY	P3REL5-1	1
P	TM 1 & 2	DELAY TIMER 1-10 SEC	ATC	319B003QIC	P3TIM2-5	2
P	SOCKET	RELAY SOCKET	CURTIS	R58-SC	P3RCT4-1	3
P	MH	POWER CONTACTOR 4P 30A	FURNAS	42B25AFL1	P3CTR7-3	1
CH	RECEPT	VIBRATOR POWER RECEPTACLE	HUBBELL	20403	P3RCT6-23	1
CH	COVER	VIBRATOR POWER RECEPTACLE COVER	HUBBELL	20405	P3RCT6-24	1
CH	BOX	VIBRATOR POWER BOX	APPLETON	FSC-1-50	P3BOX1-11	1
CH	BOX	CONTROL SIGNAL INLET BOX	APPLETON	FS-1-50	P3BOX1-10	1
CH	COVER	CONTROL SIGNAL INLET BOX COVER	APPLETON	FSK-1B-CA	P3BOC1-6	1
CH	INLET	CONTROL SIGNAL INLET RECEPT	HUBBELL	7595	P3RCT6-19	1
CH	TB 2	SENSOR TERMINAL STRIP	CURTIS	EX-8	P3TRB1-8	1
CH	HEATER	CHAMBER HEATER 2.25KW @ 230V	THERMOTRON	EL-1132-5	T3HTR32-5	2
CH	CIRC MTR	1/6HP CIRCULATOR MOTOR 3.9A	DOERR	63933	P3MTR1-3	1
CH	HLS	CHAMBER MANUAL RESET HEAT LIMIT	BARKSDALE	MTINGH35ORD	P3THT7-1	1
CH	HL	HEATER HEAT LIMIT 460°F	BUSS	WUY	P3THT12-2	2
CH	T/C 1	CONTROLLER THERMOCOUPLE TYPE T	THERMOTRON	151002	P4ACS151002	1
CH	T/C 2	PRODUCTSAVER THERMOCOUPLE TYPE T	THERMOTRON	151004	P4ACS151004	1
CH	SENSOR	100 OHM PT RTD SENSOR	SOSTMAN	4150	P3SNR3-6	1
CH	L	50 WATT CHAMBER LIGHT	G E	A19	REF	-
CH	SOCKET	LIGHT SOCKET	PAULDING	50721BR	REF	-
CH	LSI	DOOR SHAKER LIMIT SWITCH	C H	E50AR1	P3PIL1-25	1
CH	ARM	DOOR SHAKER LIMIT SWITCH ARM	C H	E50KL547	P3PIL1-22	1
CO	CONTROLLER	TEMPERATURE CONTROLLER	THERMOTRON	012003	T3ACS012003	1
CO	TB 1	CONTROL CIRCUIT TERMINALS	SQUARE D	9080KCA1	P3TRB3-1	41
CO	TB KIT	TERMINAL END KIT	SQUARE D	9080K1	REF	1
CO	F 7	SOLID STATE PROTECTION FUSE	BUSS	ABC-5	P3FUS1MIS-4	1
CO	FUSE BLK	FUSE HOLDER	BUSS	HKP	P3FUS1MIS-4	1
CO	SW 1-5	SPST TOGGLE SWITCH	C H	7500K14	P3SWH3-1	5
CO	SW 6	SPDT W/C/OFF TOGGLE SWITCH	C H	7502K13	P3SWH3-11	1
CO	R	NEON PILOT LAMP	IND DEV	1050QA1	P3LAM3-1	6
CO	CRY 1-3	SOLID STATE RELAY 10A	CRYDOM	02410	P3REL1-1	3
CO	SW PANEL	SWITCH PANEL	THERMOTRON	I-2014	REF	-
CO	RECORDER	TEMPERATURE RECORDER	HONEYWELL	452	624CUS8	1
CO	CHART	RANGE -125°F to +375°F	HONEYWELL	16381	P4CHT2-195	180X
CO	TAPE COMM	TAPE COMMAND PROGRAMMER	THERMOTRON	015023	T3ACS015023	1
CO	PRODUCTSAV	PRODUCT TEMPERATURE LIMIT	THERMOTRON	012005	T3ACS012005	1
CO	SP ASS'Y	SETPOINT ASSEMBLY	THERMOTRON	013006	T3ACS013006	1
CO	SP IND	SETPOINT INDICATOR	THERMOTRON	013007	T3ACS013007	1
EC	CONNECTOR	MS CUSTOMER CABLE CONNECTOR	AMPHENOL	MS3102A18-1P	1990	1
EC	CABLE	10 CONDUCTOR CALBE	BELDEN	8456	2608	60FT
M	R13-R502	5HP MOTOR COMPRESSOR	COPELAND	MRF2-0500-TFD	REF	-
M	CF	MOTOR COMPRESSOR HEAD FAN	COPELAND	050-0167-01	REF	-
M	PS 5	HI/LO PRESSURE SWITCH	PENN	P70NA1	REF	-
M	OPS 4	OIL PRESSURE SWITCH	PENN	P45NCA12	REF	-
M	BLOW MTR	SOUND DEADEN BLOWER	DAYTON	2C647	REF	-
M	SOL 28	LARGE LIQUID SOLENOID	SPORLAN	B6F1	REF	-
M	SOL 29	SMALL LIQUID SOLENOID	SPORLAN	A3F1	REF	-
M	SOL 31	BYPASS SOLENOID	SPORLAN	B6F1	REF	-
M	TAB	ITEMS: 10, 12	THERMOTRON	2900	T1TAB	1EA
M	T	1KVA TRANSFORMER	JEFFERSON	211-071	P3XF06-7	1

THERMOTRON
 CORPORATION
 D, MICHIGAN 49423

NO	CHANGES	DATE	BY	CHKD	NO	CHANGES	DATE	BY	CHKD	TOLERANCE	CENTRION
										SCALE	
										MATERIAL	
										FINISH	
										DRAWN BY	
										CHECKED BY	
										RELEASED BY	

W

PART NO.

Y

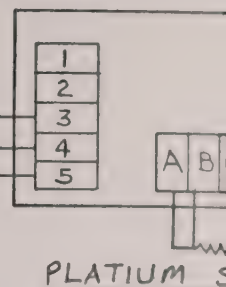
MH 452 RECORDER

NOTES:

(*) BELDEN CABLE I.D.

A+B P3WII2-7 2-COND
 C P3WII2-5 3-COND
 D P3WII2-9 7-COND

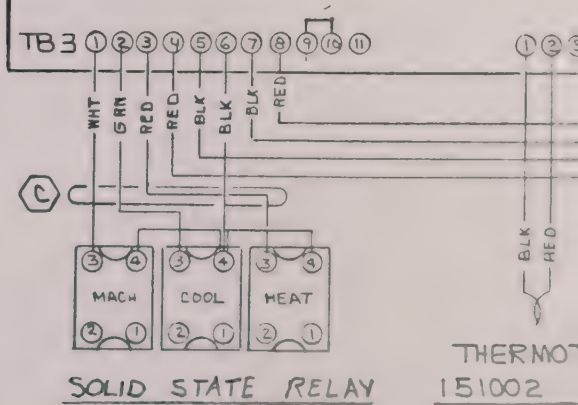
EARTH
 LINE
 NEUTRAL



PLATINUM S

EARTH
 NEUTRAL

THERMOTRON 012003 CONTROLL

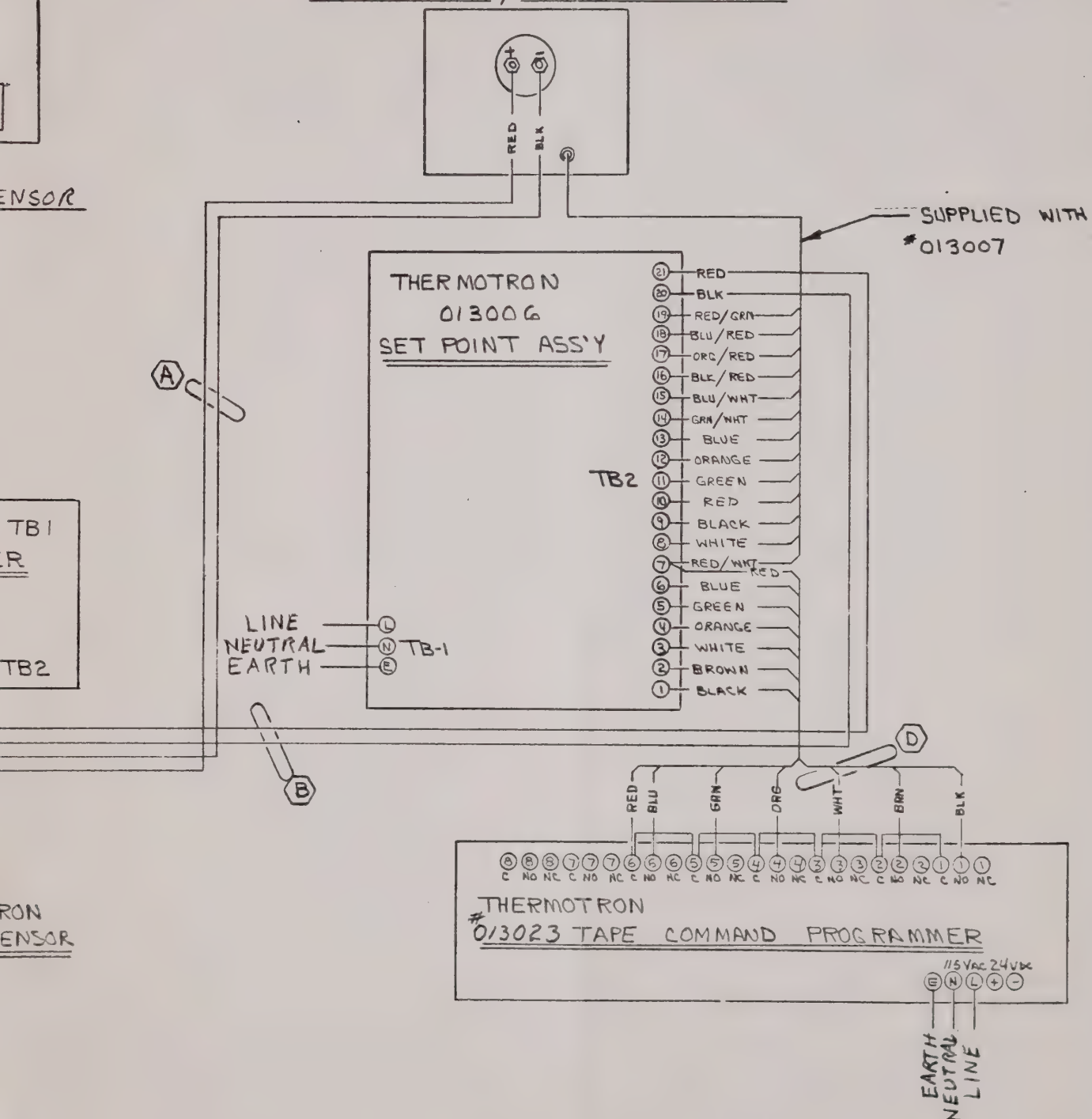


SOLID STATE RELAY

THERMO
151002

SYM	DATE	CHANGE
A		
B		
DESIGN BY	DATE	SCALE
R. HOSLEY	1-30-75	

THERMOTRON 013007
S.P. INDICATOR / CONTROL STATION



W.O.#

SY	SYM	DATE	CHANGE	BY	MATERIAL	REFERENCE	DESCRIPTION	FOR	DRAWING NO.	SIZE
	C									
	D									
INSTRUMENTATION SYSTEM WIRING								SYSTEM 819	I-2045-8,9	Y

THERMOTRON CORP.
 HOLLAND, MICHIGAN U.S.A.

FREON 13 SYSTEM

CHARGING PROCEDURE

WHEN TO ADD: Refrigerant will need to be added when the standby pressure of the system falls sufficiently below the level recorded on the equipment serial tag (located on the electrical compartment door) that it impairs proper chamber performance.

MATERIAL REQUIRED: 1 set of manifold refrigeration gauges, three charging hoses, one tank of Freon 13.

Note: Freon 13 at ambient temperature is at a pressure exceeding 450 PSI. Extreme care should be taken in handling this gas.

CHARGING PROCEDURE:

1. Connect the charging hoses to the refrigeration gauges.
2. Connect the center charging hose to the Freon 13 tank outlet valve. (Be sure the valve is OFF.)
3. Turn the compressor discharge and suction service valves all the way counter-clockwise; backseating the valves.
4. Connect the suction gauge hose to the compressor suction service valve. Connect the discharge gauge hose to the compressor discharge service valve.
5. Open the hand valves on the gauge manifold and bleed (purge) a small amount of gas through the charging hose.
6. After the hoses are purged, close the Freon 13 tank outlet valve and tighten the hose fittings on the compressor service valves.
7. Turn the compressor suction and discharge service valves clockwise (half turn only). Any charge in the system will be read on the gauges. This charge is referred to as the standby pressure. To read the proper pressure, the chamber and cascade compartment must be at ambient temperature.
8. To add gas, slowly open the outlet valve on the Freon 13 tank, allowing the higher pressure gas in the tank to flow into the refrigeration system; when the gauge reads the proper standby pressure, close the outlet valve of the Freon 13 tank.
9. Allow the unit to stand for 15 minutes and recheck the standby. It will probably be necessary to add more gas. Again, open the outlet valve on the Freon 13 tank and raise the standby to the proper level. Close the valve.

10. Allow the chamber to stand approximately 15 minutes and recheck the standby. This procedure may be followed until the proper standby is reached.
11. After the standby is reached, turn both hand valves on the manifold all the way clockwise. (Frontseat.)
12. With the hand valves in this position, the operating pressures of the system may be read when the equipment is running.
13. If it is desired that the gauges be removed, backseat both compressor service valves (turned all the way counter-clockwise) and remove the charging hoses.

FREON 502 SYSTEMCHARGING PROCEDURE

WHEN TO ADD: Refrigerant will need to be added when bubbles appear in the sightglass; during pulldown after 2 minutes of operation.

MATERIALS REQUIRED: One set of manifold refrigeration gauges, three charging hoses, one tank of Freon 502.

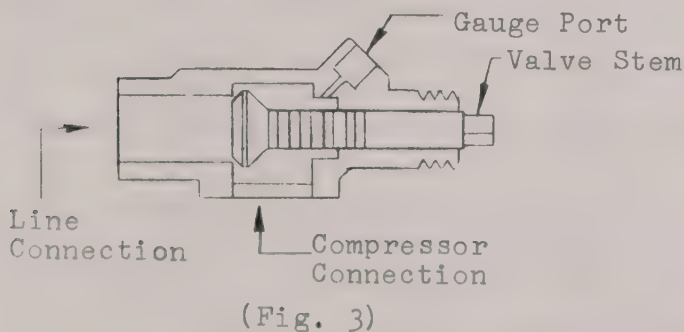
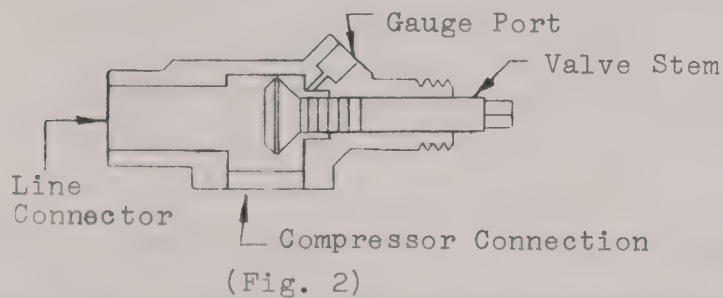
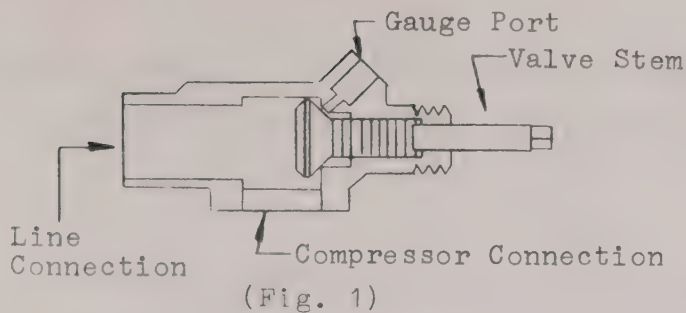
PROCEDURE:

1. Connect the three charging hoses to refrigeration gauge manifold.
2. Connect the center charging hose to the Freon 502 tank. (Outlet valve of tank must be OFF.)
3. Turn the suction and discharge service valves on the compressor all the way out (backseat).
4. Connect the hose from the suction gauge to the compressor suction service valve. Leave the fitting loose.
5. Connect the hose from the discharge gauge to the compressor discharge service valve. Leave the fitting loose.
6. Open both hand valves on the refrigeration gauge manifold.
7. Slowly open the outlet valve on the Freon 502 tank and purge the charging hoses.
8. Tighten the hose connections on the compressor suction and discharge service valves.
9. Turn the discharge hand valve on the refrigeration gauge manifold all the way clockwise (frontseat). The suction hand valve should remain open.
10. Turn the compressor section and discharge service valves clockwise (half turn only). Any charge in the system will be read on the gauges.
11. Start the R-502 compressor and watch for bubbles in the sightglass. This must be checked on the pulldown after a minimum of two minutes of running.
12. Open the outlet valve on the Freon 502 tank and allow the refrigerant to flow until there are no bubbles in the sightglass.

13. Turn OFF the outlet valve on the Freon 502 tank.
14. Continue to watch the sightglass for bubbles during normal pulldown operation. If bubbles appear, more Freon 502 may have to be added.

NOTE: If bubbles appear during the bypass operation, this does not indicate a low charge.

15. To use the gauges during compressor operation, both hand valves should be turned all the way in (frontseated).
16. To remove the gauges, turn the compressor section and discharge service valves all the way counter-clockwise (backseat) and remove the charging hoses.



TERMINOLOGY

Purge - Blowing out gas for the purpose of removing noncondensables.

Frontseat - To cause the valve to seat against the front valve seat, as in Fig. 3.

Backseat - To cause the valve to seat against the back valve seat, as in Fig. 1.

Charge - The amount of refrigerant in a system; to put in the refrigerant charge.

Bypass - The refrigerant is directed to a bypass heat exchanger instead of the cooling coils. This is in effect a no cooling condition.

Heat-Up - That condition where the temperature goes from a lower to a higher level.

Pull-Down - That condition where the temperature goes from a higher level to a lower level.

In the day to day operation of this equipment, you will become aware of certain levels of noise, vibration, temperature and pressure.

If you encounter any significant changes in these levels, investigate them immediately.

You should also develop a preventive maintenance program of this equipment.

To assist in the construction of this program, Thermotron has prepared a list of preventive maintenance routines. While this list is not all inclusive, and in some cases may refer to items not present in your system, it will serve as a good base on which to build your own custom preventive maintenance program.

The establishment of such a program will add significantly to the life of the equipment and will establish the unscheduled down time on the equipment at an absolute minimum.

THERMOTRON

SUGGESTED
PREVENTIVE MAINTENANCE INTERVALS

Inspect	Daily	Weekly	Monthly	Quarterly	Semi-Annually	Annually	Routing No.
Vacuum Pump	X						1
R-502 Charge		X					2
R-13 Stand-by		X					3
Compressor Oil Level		X					4
Blower Belts & Pulleys			X				5
Circulator Motor			X				6
Humidity System			X				7
Electrical Panel			X				8
Operating Currents			X				9
Oil Pressure				X			10
Condenser (Air Cooled)				X			11
Oil Cooler					X		12
Condenser (Water-Cooled)						X	13
Tubing Abrasion			X				14

PREVENTIVE MAINTENANCE ROUTINE DESCRIPTIONS

7.5.2

VACUUM PUMP

4.

COMPRESSOR OIL LEVEL

1. The oil level should be checked each day the vacuum pump will be run. Other checks such as belt tension, RPM, oil cleanliness and others will have to be performed on an "as required" basis, depending on how much the vacuum pump is used.

With the compressors running, the oil level should be maintained halfway on the sightglass. Oil leakage should not be tolerated. Any deviation from the normal oil level should be investigated immediately.

R-502 CHARGE

5.

BLOWER BELTS AND PULLEYS

2. Observe the sightglass to see if there are any bubbles. This should be checked during pull-down after at least 2 minutes of operation. Bubbles indicate a lack of refrigerant. If bubbles are seen during bypass operation, this does not indicate a gas shortage.

Check the blower pulleys for rough surfaces or edges that could wear the belt. Also, check for tightness on the motor shaft. Check the belt for wear and tension.

6.

CIRCULATOR MOTOR

3. Also, observe the color of the moisture indicator in the sightglass. Green is dry; yellow-green (chartreuse) is caution; and yellow indicate moisture.

On conventional chambers, check the rotation of the fan (suction at the grill) and check the fan for tightness on the motor shaft.

On altitude chambers and additional check must be made to see that the oil level is maintained in the oil cups on the motor.

R-13 STANDBY

If gauges are permanently attached the standby may be read on the R-13 discharge gauge prior to the day's operation if the equipment has been turned OFF overnight.

If the equipment has been running the chamber (and cascade section) must be at ambient temperature and equalized to read the standby pressure. The factory stand-by pressure is recorded on the serial tag located inside the electrical compartment door.

PREVENTIVE MAINTENANCE ROUTINE DESCRIPTION

7.5.3

HUMIDITY SYSTEM

Check to see if the wet bulb sock is collecting any deposits from the water. This should be changed periodically depending on the water conditions. Also, make a visual inspection of the humidity system, checking for water deposits and leaks.

ELECTRICAL PANEL

Check for components and wires that may vibrate loose during operation. Check for signs of contactor or relay arcing. Check to see the power and ground connections remain secure.

OPERATING CURRENTS

With an amprobe, check the operating current of the compressors, heaters, circulators and other components. These values are shown on the electrical schematic.

OIL PRESSURE

The oil pressure should run from 15 to 50 PSIG above the suction pressure of the compressor. A reading below 15 PSIG should be investigated immediately.

AIR COOLED CONDENSER

The air-cooled condenser should be cleaned quarterly. This period may be extended if operating conditions warrant it.

OIL COOLER

The oil cooler should be cleaned every six months if conditions warrant it. This period may be extended.

WATER-COOLED CONDENSER

Annually check the condenser for build up of scale on the condensing surface. This interval may need to be shortened if the buildup is of a substantial amount.

TUBING ABRASION

Check for evidence of friction wear on all refrigeration lines. Particular care should be taken on inspecting capillary tubes to pressure switches and gauges. This check should be made each time the refrigeration machinery panels are removed.

MAINTENANCE
TROUBLESHOOTING GUIDE

Symptoms	Causes	Remedy
A. Compressor does not run.	1. Main power disengaged.	1. Close main power disconnect or equipment disconnect switch.
	2. Fuse blown.	2. Replace fuse.
	3. Contacts on compressor contactor inoperative.	3. Repair.
	*4. Refrigerations reset circuit open.	4. Refer to Section M.
	5. Compressor seized.	5. If the compressor has caused the inherent overloads to trip, allow time for the compressor to cool and the inherent overloads to reset. Change one phase of the compressor power to reverse compressor rotation. Restart the compressor. If compressor will not start, notify the factory for further assistance.
	6. Contactor control circuit open.	6. Check for open control circuit.
B. Unit short cycles continuously.	1. Instrument control differential set too closely.	1. Widen differential.
	2. Time-out circuit set too low.	2. Increase "Time-out" time.
C. Compressor will not start - hums intermittently. (Cycling on overload.)	1. Improperly wired	1. Check wiring against diagram.
	2. Low line voltage.	2. Check main line voltage - determine location of voltage drop.

* Optional - not present on all systems

Symptoms	Causes	Remedy
C. (Continued)	*3. Open starting capacitor.	3. Replace starting capacitor.
	4. Open contactor contact.	4. Make physical inspection of contacts or substitute a new contactor.
	5. Open circuit in starting winding.	5. Make a continuity check of the starting winding.
	6. Stator winding grounded.	6. Make a continuity check from the stator winding to ground.
	7. High discharge pressure.	7. Check for refrigerant overcharge or noncondensables.
	8. Tight compressor.	8. Check oil level - correct binding.
D. Compressor starts, motor will not get off starting winding.	1. Low line voltage.	1. Bring up voltage.
	2. Improperly wired.	2. Check wiring against diagram.
	3. Defective start - run relay.	3. Check operation Manually; replace relay if defective.
	*4. Running capacitor.	4. Check by disconnecting running capacitor.
	5. Starting and running windings shorted.	5. Check resistances. Replace stator if defective.
	6. Starting and running windings shorted.	6. Check capacitance. Replace if low.
	7. High discharge pressure.	7. Check for refrigerant overcharge or noncondensables.
	8. Tight compressor.	8. Check oil level. Check binding.

E. Start Run Relay burn out.	1. Low line voltage.	1. Increase voltage to not less than 10% under compressor motor rating.
	2. Excessive line voltage.	2. Reduce voltage to maximum of 10% over motor rating.
	*3. Incorrect running capacitor.	3. Replace running capacitor with correct mfd. capacitance.
	4. Short cycling.	4. Reduce number starts per hour. (See Section B.)
	5. Incorrect mounting.	5. Mount relay in correct position.
	6. Incorrect relay	6. Use relay properly selected for motor characteristics.
	7. Relay vibrating.	7. Mount relay in rigid location.
F. Insufficient cooling effect.	1. Refrigerant shortage.	1. Repair leak and recharge.
	2. Frosted coil.	2. Defrost and dry coil.
	3. Low air circulation.	3. Check fan rotation.
	4. Compressor inefficient.	4. Check for tightness of defective valves.
	5. Cooling coils obstructed.	5. Remove obstruction.
G. R-13 Head Pressure too high.	1. Refrigerant overcharge.	1. Purge.
	2. Air in system.	2. Purge.
	3. R-502 system short of gas.	3. Repair leak and recharge.

Symptoms	Cause	Remedy
H. R-13 Head Pressure to low.	1. Refrigerant shortage.	1. Repair leak and recharge.
	2. Compressor suction or discharge valves inefficient.	2. Clean or replace leaky valve plates.
I. R-502 Head Pressure too high.	1. Condensing water (air) too warm.	1. Supply cooling water (air).
	2. Restricted water (air) cooled condenser.	2. Clean or replace condenser.
	3. Water valve too far closed.	3. Adjust valve for 200# head pressure.
	4. Air in system.	4. Purge.
J. R-502 Head Pressure too low.	1. Condensing water (air) too cold.	1. Adjust water valve for 200# head pressure.
K. Noisy unit.	1. Insufficient compressor oil.	1. Add oil to proper level.
	2. Tubing rattle.	2. Bend tubes away from contact.
	3. Mountings loose.	3. Tighten.
	4. Oil slugging or refrigerant flooding back.	4. Correct cause of floodback.
L. Compressor loses oil.	1. Shortage of refrigerant.	1. Repair leak and recharge.
	2. Machinery section remote or system change made.	2. Add oil until sight-glass is half full when running.

Symptoms

L. (Continued)	3. Short cycling. 4. Superheat too high at compressor suction.	3. Refer to Part B. 4. Change location of expansion valve bulb or adjust valve to return wet gas to compressor.
*M. Refrigeration reset light ON.	1. Nuisance tripping due to line fluctuation. 2. Solid state module failure drop-out. 3. Inherent overload protection open. (R-13 or R-502 system) 4. R-13 discharge temperature limit open. 5. R-502 discharge temperature limit open. 6. R-13 or R-502 oil differential switch open.	1. Check line with a voltmeter or recorder. 2. Check for excessive vibration on compressor. Install new module. 3. These protectors require approximately 15 minutes to 15 minutes, reset and measure the three phase compressor current. 4. This thermostat requires approximately 3 minutes to reset. If the R-13 unit is open, check to see if the R-13 injection valve is feeding. Also, check the R-13 standby. 5. Check the R-502 charge 6. Reset and check compressor oil level. If tripping occurs, contact the factory for assistance.

* Optional - not present on all systems.

Symptoms	Cause	Remedy
M. (Continued)	7. R-13 Hi-Lo pressure switch open.	7. Open on low-check the R-13 standby pressure. Also check the rotation of the circulator fan. Open on high-check the R-502 sightglass for bubbles (indicating a low charge).
	8. R-502 Hi-Lo Pressure switch open.	8. Open on high - check the refrigeration water supply. Open on low - check the R-502 charge.
	9. Crankcase thermostat open.	9. Allow sufficient time for the crankcase heater to warm the oil. Crankcase heater could be open or the crankcase thermostat defective.



THERMOTRON
Nationwide
Service for
Environmental
Chambers and
Instruments



FIELD SERVICE

Murphy's law states "if something can go wrong, it will." Thermotron's Field Service law says "that's not necessarily so, but if it does, we'll fix it and quick too." And that's where Thermotron's Field Service program comes in. It exists simply because no matter how well we build our environmental simulation chambers and instruments, things sometimes can go wrong.

When it does, it costs you, our customer, time, money, and inconvenience. It's our goal to prevent breakdowns before they happen. And when that isn't possible, to make sure we put your equipment back in perfect working order quickly, efficiently and economically.

To do it, we've assembled a nationwide service network. It includes regional, branch and factory service technicians and representatives skilled in all facets of servicing sophisticated environmental test simulators and chambers.

The map inside shows how far we've come and what the future holds. We also provide a brief explanation of the ways in which we can help you keep your Thermotron equipment operating at peak efficiency. Please feel free to contact me if you have any comments or questions about Thermotron Field Service — my hot line is 616-392-1492.

Sincerely,

Robert G. Wiley

THERMOTRON CORPORATION
Robert G. Wiley
General Service Manager



THERMOTRON CORPORATION

Holland, Michigan

PRODUCT SUPPORT

EQUIPMENT MAINTENANCE CONTRACT

Date _____

Purchaser:

Model No. _____

Serial No. _____

P. O. # _____

Thermotron Corporation guarantees the service and materials under this contract which are in accordance with Thermotron Corporation specifications, if any part of said Thermotron services or material used by Thermotron Corporation as determined by the Service Engineer is defective in workmanship or material and not subject to misuse or abuse.

- (A) Within thirty (30) days from date of installation, Thermotron Corporation will exchange and install a replacement part in place and instead of the said defective part without charge;
- (B) Within a period beginning with the expiration of the above mentioned period and ending ninety (90) days from date of installation, Thermotron Corporation will furnish an exchange part for the defective one f.o.b. plant, Holland, Michigan, and installation and cost of installation thereof will be the responsibility of the customer;
- (C) Exceptions: Thermotron Corporation shall guarantee to the extent of the original supplier warranty. On items such as expansion valves, relays, thermostats, limit controls, motors, receivers, vapor tanks, condensers, gauges, transformers, heaters, and compressors, the warranty is one year from date of installation;
- (D) Thermotron Corporation will not honor warranties on such items as freons (502, 13, 22, 12) or any other type used as a refrigerant.

1. Furnish all labor, material, tools, and equipment required to service and maintain environmental test equipment, as set forth below, during the period commencing _____ and ending _____ on the terms and conditions set forth herein.
2. Service rendered hereunder shall cover normal maintenance such as, but not necessarily limited to, inspection and adjustment.
3. A total of _____ scheduled calls shall be made as follows:
 - _____ - Normal maintenance
 - _____ - Normal maintenance
 - _____ - Normal maintenance
 - _____ - Normal maintenance
4. Emergency service calls shall be made on an "as needed" basis as requested by _____ and at the regular rates indicated elsewhere herein.
5. Only trained personnel qualified in maintenance and repair shall service this equipment.
6. Detailed maintenance reports shall be filed in triplicate with the _____ representative for maintenance service call. The report shall be in the form of a detailed list, signed and certified by the Thermotron Service Engineer responsible for the service rendered.
7. When receiving the report based upon Thermotron's Service Engineer's evaluation, and if items are to be replaced, it will be negotiated in a time/material contract covered by a separate purchase order number.
8. Replacement parts furnished by Thermotron will be billed at current retail prices. _____ may furnish the required replacement parts if desired.*

* Parts furnished by _____ will be evaluated and approved for use by Thermotron Service Engineer before installation.

9. Each chamber qualifying after each checkout shall receive a label stating date of next inspection, and shall be signed by the Thermotron Service Engineer making the call.
10. Charges for services rendered under this agreement shall be computed at the following rates, except as noted below:
- a. Labor: Monday through Friday @ \$_____ per hour.
Saturdays, Sundays, holidays, and hours in excess of 8 on weekdays @ \$_____ per hour.
Travel time @ \$_____ per hour.
 - b. Transportation: Surface @ \$_____ per mile and tolls.
Air - Actual cost of tourist class fare except those flights with one-class fare.
Other - At actual cost.
 - c. Per Diem: Room - Actual cost.
Food - \$_____ per day.
- NOTE: In the case or work performed by independent authorized subcontractors of Thermotron, per diem is not an allowable item of cost.
11. Invoices shall be rendered in triplicate and shall reference this Agreement Number _____ and shall be detailed in such a manner as to reflect the cost of servicing each of the chambers with subtotals shown for Group No. 1 and Group No. 2 with 50% of the total cost for travel and subsistence applied to each group.

Invoices, with supporting data, shall be forwarded to:

12. In providing the described normal maintenance and emergency services, it is anticipated that Thermotron Corporation will provide a factory service engineer for the routine services. It is also agreed that Thermotron Corporation has the option of providing a local, authorized contractor for minor adjustments or emergency service, if that is in the best interests of expediting job operation continuity.

Thermotron Corporation shall not be liable under this service agreement or contract for any operational delays or consequential damages, and the customer assumes all risk and liability whatsoever resulting from the use of such equipment and materials.

This service contract cannot be modified in any way except by a written instrument duly executed by Thermotron Corporation and the customer.

Date _____

Yearly Total _____

Accepted and Approved By:
(Purchaser)

Title

Accepted and Approved By:
(Thermotron)

Title

Keep them working; fix them when they fail.

Thermotron Field Service is more than just a repair operation. We put as much emphasis on *preventing* problems before they happen as on fixing them when they do.

Field Service

There are 45 Thermotron service technicians and representatives located throughout the United States. Each is highly skilled, and intimately familiar with both the theoretical and practical aspects of environmental simulation chambers.

You may have come in contact with one of them even though you've never experienced a problem with a Thermotron chamber. Many of our more complex chambers require factory-supervised installation and start-up. A technician performs it in your facility, and he stays on the job until the equipment is operational and your personnel are skilled in its operation and general maintenance.

Field technicians also perform warranty service, of course. (Thermotron products carry a 90-day labor warranty and one-year parts warranty*).

But perhaps their most important function is the contract service program. Call it planned maintenance, or preventive maintenance, or whatever you want, the results are the same—more efficient equipment operation and virtual elimination of costly, inconvenient downtime. Several contract maintenance programs are available to fit your specific requirements.

Parts.

No matter how skilled a technician may be, he's just another guy if he doesn't have the right replacement parts. We don't intend to let that happen.

Our first line of defense involves local service trucks. They're all stocked with a complete inventory of the most frequently needed parts. And they're ready to roll when you need help. Regional supply depots carry a more extensive parts inventory. Seldom will the depot nearest you be unable to fill a replacement part order. If it ever *does* happen, the main factory warehouse at Holland, Michigan will air-ship any part within 24 hours.

Parts aren't a problem. Not when you have Thermotron chambers.

Training.

In addition to providing comprehensive training to our technicians, we'll school your laboratory technicians and supervisory personnel in the techniques of chamber operation and preventive maintenance. The sessions are provided to you free of charge. Your only expense will be for travel and lodging for your personnel. When necessary, we will conduct training sessions in your plant. On-site training programs are generally feasible only when a large number of your employees can participate. A nominal fee is charged to cover the expenses of our Field Service Instructors.

To round out the program, we provide comprehensive technical manuals and handbooks on the operation and maintenance of Thermotron equipment.

A total program.

From the moment you install your Thermotron environmental simulation chamber you'll be assured of the most professional field service in the industry. We welcome the opportunity to be of assistance.

REGION 1 — WEST COAST

Regional Office:

8934 Mason Avenue
Chatsworth, CA 91311
Phone: (213) 882-5030

Branch Offices:

50 Curtner Avenue
Campbell, CA 95008
Phone: (408) 371-5961

San Diego/San Marros
Phone: (213) 882-5030

Representative

Seattle, Washington

REGION 2 — CENTRAL STATES

Regional Office:

14001 Goldmark Drive
Suite 218
Dallas, TX 75240
Phone: (214) 231-3663

Representatives:

Albuquerque, NM
Denver, CO
Ozark, AR

REGION 3 — MIDWEST

Regional Office:

Kollen Park Drive
Holland, MI 49423
Phone: (616) 392-1492

Representatives:

Chicago, IL
Detroit, MI
Indianapolis, IN
Minneapolis, MN

REGION 4 — EAST/NORTHEAST

Upper New York State
For Service Call:
Holland, MI
Phone: (616) 392-1492

Representatives:

Boston, MA
New York, NY
Newark, NJ
Washington, D.C.

REGION 5 — SOUTH/SOUTHEAST

Regional Office:

122 North Kirkman Road
Suite D
Orlando, FL 32811
Phone: (305) 293-7700

Representatives:

Atlanta, GA
Miami, FL
Huntsville, AL

THERMOTRON HOT LINE (616) 392-1492

THERMOTRON



Kollen Park Drive, Holland, Mich. 49423 U.S.A.
Phone (616) 392-1492 TWX No. 810-292-6164

HERMOTRON

CORPORATION

Kollen Park Drive, Holland, Mich. 49423 U.S.A.
Phone (616) 392-1492 TWX No. 810-292-6164



Dallas Area Office
14001 Goldmark Drive
Suite 218
Dallas, Texas 75240
Phone: (214) 231-3663

Los Angeles Area Office
8934 Mason Avenue
Chatsworth, California 91311
Phone: (213) 882-5030

New York Area Office
1850 Lansdowne Avenue
Merrick, New York 11566
Phone: (516) 223-7485

Detroit Area Office
4514 N. Woodward Avenue
Royal Oak, Michigan 48072
Phone: (313) 549-3910

Florida Area Office
122 N. Kirkman Rd., Suite D
Orlando, Florida 32811
Phone: (305) 299-3617

San Francisco Area Office
50 Curtner Avenue
Campbell, California 95008
Phone: (408) 371-5961



MP 38262